

Compact High Performance Plasma Propulsion System, Phase I

Completed Technology Project (2018 - 2019)



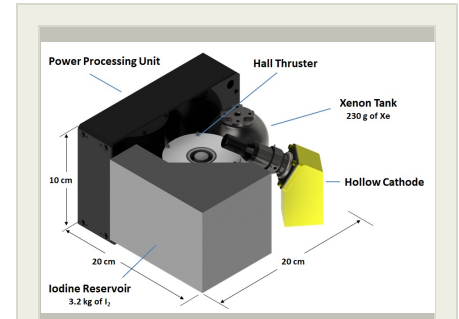
Project Introduction

The Compact High Performance Plasma Propulsion System (CHPPPS) is an electric propulsion system for 12U – 27U CubeSats. CHPPS is designed for high-value science missions which require high specific impulse, high reliability, and radiation tolerance. CHPPPS includes a low power Hall Effect Thruster (HET), a hollow cathode for neutralizing the ion beam, a propellant management system, and a power processing unit (PPU). The system is highly modular and appropriate for 12U – 27 U CubeSats in terms of size, mass, and power. CHPPPS may be as small as 4U, depending upon the fuel load and specific component selection. Thrust will be 3-8 mN, depending on the power supplied (60 – 135 W) and peak specific impulse will be >1100 s. The thruster will be fueled with xenon or with game-changing iodine, which stores as a solid at very low pressure and much higher density than xenon. The use of iodine significantly decreases spacecraft dry mass, and dramatically decreases propellant volume. The impact of switching from xenon to iodine is most significant for volume limited spacecraft like CubeSats. Whether the thruster is fueled by xenon or by iodine, the ion beam will be neutralized by a hollow cathode flowing noble gas. The thruster will be powered by a compact, radiation tolerant power processing unit (PPU) previously developed for NASA and Air Force applications. ACS may be provided by cold gas thrusters fed from the noble gas storage system. In Phase I, the system design will be detailed and studied. Work will include a proof of concept hardware demonstration at relevant power levels.

Anticipated Benefits

The proposed system would propel a small earth orbiting or interplanetary spacecraft, targeting 12U and 27U CubeSats and small satellites. Applications include orbit raising and lowering, compensating for drag at low altitude, de-orbiting a spacecraft at EOL, changing orbit inclination and phase, NS and EW station-keeping in GEO, and constellation deployment and maintenance. The system also enables a low cost demonstration of HET magnetic shielding with iodine propellant.

The integrated system will be actively marketed spacecraft platform providers, targeting CubeSats and small commercial buses. Commercial and DoD applications include orbit raising and lowering, compensating for drag at low altitude, de-orbiting a spacecraft at EOL, changing orbit inclination and phase, NS and EW station-keeping in GEO, and constellation deployment and maintenance.



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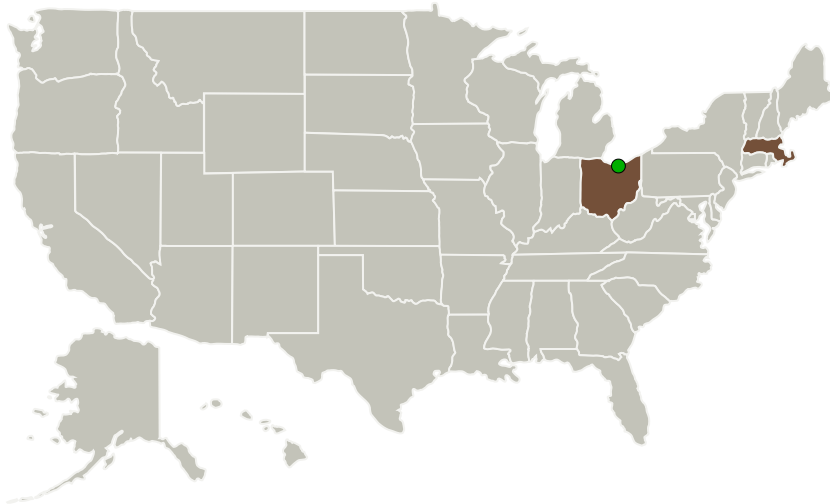
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Primary U.S. Work Locations and Key Partners



Organizations Performing Work	Role	Type	Location
Busek Company, Inc.	Lead Organization	Industry Women-Owned Small Business (WOSB)	Natick, Massachusetts
● Glenn Research Center(GRC)	Supporting Organization	NASA Center	Cleveland, Ohio

Primary U.S. Work Locations

Massachusetts	Ohio
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Project Transitions

▶ **July 2018:** Project Start

Organizational Responsibility

Responsible Mission Directorate:

Space Technology Mission Directorate (STMD)

Lead Organization:

Busek Company, Inc.

Responsible Program:

Small Business Innovation Research/Small Business Tech Transfer

Project Management

Program Director:

Jason L Kessler

Program Manager:

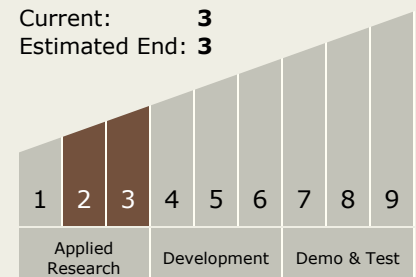
Carlos Torrez

Principal Investigator:

James Szabo

Technology Maturity (TRL)

Start: **2**
 Current: **3**
 Estimated End: **3**



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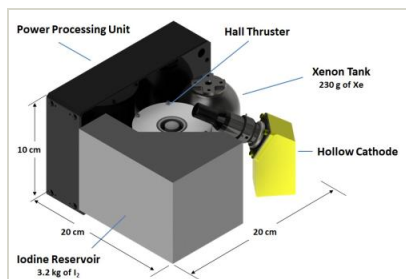


✓ **February 2019:** Closed out

Closeout Documentation:

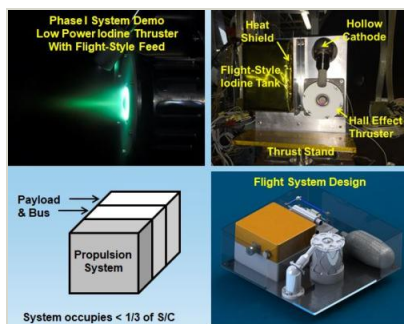
- Final Summary Chart(<https://techport.nasa.gov/file/141311>)

Images



Briefing Chart Image

Compact High Performance Plasma Propulsion System, Phase I
(<https://techport.nasa.gov/image/127968>)



Final Summary Chart Image

Compact High Performance Plasma Propulsion System, Phase I
(<https://techport.nasa.gov/image/130075>)

Technology Areas

Primary:

- TX01 Propulsion Systems
 - TX01.2 Electric Space Propulsion
 - TX01.2.2 Electrostatic

Target Destination

Earth